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FIRST EXPERIMENTS IN THE TREATMENT OF GRAPE-VINE MILDEW IN THE BOMBAY PRESIDENCY.

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PREFACE.

The experiments here recorded were carried out by myself and Mr. G. B. Patwardhan, B.Sc., Assistant Economic Botanist, in consultation with Mr. E. Little, Superintendent of Government House Gardens, Bombay, to whom I am deeply indebted for his ready help and expert advice.

WILLIAM BURNS.

Poona, April 1910.

FIRST EXPERIMENTS IN THE TREATMENT OF GRAPE-VINE MILDEW IN BOMBAY PRESIDENCY.

I. *The appearance and nature of mildew.*—The term mildew is used to describe many diseases of plants which cause a white furry or powdery coating on any part of the plant. Such a disease is a serious pest of the grape vine in all countries where it is grown, and India is no exception to that rule. Mildew is usually known as *Bhuri* in centres of grape cultivation in the Bombay Presidency. Its appearance is unmistakable. When the fruits are about the size of a pea, a white powder, like flour, appears on the surface of the berries. The grapes do not develop properly. They finally crack and become blackened and worthless. If the vine is closely watched before this powder appears on the bunches, it may be observed that patches of the powdery substance are present also on the leaves and young shoots. Often however, such patches appear on the fruits and shoots about the same time. The effect on leaves and shoots is to cause brown dead patches here and there. What is this powdery substance and how does it do such damage? The powdery substance is really the body of a peculiar plant which lives on the grape vine. The body of this plant is made up of many small fine white threads. These threads send out small projections like roots into the fruits, leaves and shoots of the grape vine and steal food from the body of grape vine, at the same time permanently injuring the tissues attacked. These threads also produce small round bodies (called spores) that act as seeds, and when these spores are blown by the wind on to a new bunch or leaf of the vine there the mildew plant starts afresh.

II. *Experiments in other countries.*—In Europe and America it has long been the practice to apply various remedies for this disease. It has been found that the disease is worst in badly drained, badly pruned, badly ventilated and unweeded vine-yards. Still air, excessive moisture, combined with warmth are the conditions that favour a bad attack of mildew. The first remedy, therefore, is to make the conditions such that mildew does not thrive well. Therefore it is necessary that irrigation should be given only when necessary, that water should not stand about in the vine-yard, that old decayed parts of the vines should be cut out, and that the soil should be kept clean. The vines should not

be grown too close together, and the branches should not be allowed to hang in one close mass; otherwise the wind cannot blow through between them and mildew will flourish.

In spite of all these precautions, however, mildew occurs though not to the same extent. To finally get rid of this mildew it has been found effective to apply various chemical preparations to the plants. Many experiments have been made with various remedies. When grapes are grown in glass houses it has often been found effective to dust powdered sulphur on the leaves and bunches. When grapes are grown in the open air, however, as in India, it has usually been found necessary to apply some kind of liquid remedy in the form of a spray. One special liquid remedy has proved itself of very great benefit, not only for grape mildew, but also for all kinds of diseases due to fungi (plants of the mildew kind). Grape vines are subject not only to mildew but to other similar diseases. It was decided to experiment on the Indian grape mildew with this remedy. This remedy is called Bordeaux mixture. How it is prepared and how it is applied will be the subject of succeeding paragraphs.

III. *Scheme of experiments on Indian grape mildew.*—It was necessary to find out whether the treatment that had been successful in other countries would also succeed in India, so a scheme of experiments was drawn up to test the value of the method on grape vines in the Bombay Presidency. To make this test conclusive it was necessary to find a centre where grapes were largely cultivated and where mildew had been doing much damage. Having found such a place it was then desirable that a certain number of the vines there should be treated with the remedies and that these treated vines should be compared with the untreated vines of the same locality. Any difference in these treated vines would then be due to the remedies alone and not to conditions of climate, etc.

We were fortunate to obtain through the kindness of Ráo Sáheb N. V. Gole, Public Prosecutor, Násik, exactly the conditions necessary for a successful experiment. Mr. Gole possesses a large amount of land under vines in Násik—a centre of grape culture. He generously put at our disposal 100 vines in his vine-yard to treat as we desired for comparison with the rest. Our treatment proposed was :—

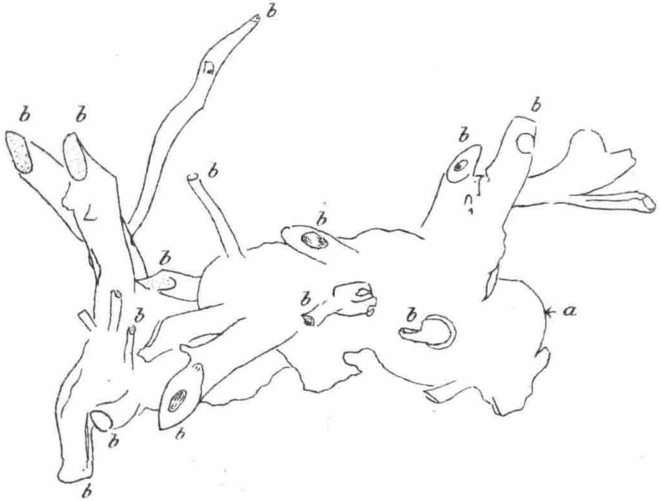
(1) Careful pruning by us.

(2) Cleansing of trees from old bark and scrubbing them.

(3) Periodic spraying with Bordeaux mixture.

A growth cut off from a nine year old Bhokri vine

Actual size.



a = where the growth was cut off from the vine.

b = ends of branches left in previous prunings.

Figure I.

Another gentleman, Mr. N. V. Kirtane of Mundwa, was also good enough to similarly place at our disposal vines in his garden at Mundwa, near Poona, which we experimented on in precisely the same way as the Násik vines.

The vines in Ganeshkhind Botanical Gardens, Poona, were all also treated in the same way.

IV. *The Násik Experiment.*—The Násik experiment was conducted as follows :—

We first visited the place on August 1st, 1909, and at that time chose out the trees for treatment and made observations on the varieties of grapes and on the mildew. The most extensively cultivated grape in Násik district is *Bhokri*, and all the vines we treated were of this variety. The other local varieties are—*Kali* and *Pandhari Phukdi,* and *Sahebi.* There is, however, no solid plantation of any of these three latter varieties. In most vine-yards the mildew attack at this time was bad. The leaves were blackened, the stems covered with white powder, and the growth had been stopped in many cases owing to the destruction of terminal buds. Several bunches of berries were seen, badly attacked, cracked and scarred. On each main stem there was a considerable layer of old dead bark. The pruning had been done so as to leave large and unsightly knots of spurs, the size and crowding of the spurs increasing with the age of the plantation. In most cases the ground was covered either with weeds or a rather poor catch crop.

The second visit to Násik was made on October 11, 1909, when operations were begun in earnest on the vines selected. The rest of the vines in the vine-yard (9-year old *Bhokri*) had already been pruned according to the local method during the previous week. The *máli* in charge went round our 100 vines pruning them with the bill-hook (*narkat*) and we followed with secateurs and put on the fine work. The growths (Fig. 1) thus removed by us were old gnarled dead spurs often rotten and occasionally with snails inside and always infested by insects. The dead bark of the stems had been removed by hand previously according to our instructions. In the evening at 5 p. m. we sprayed with Bordeaux mixture that had been mixed that same morning. The Bordeaux mixture was prepared thus : We took 3 lbs. copper sulphate (*morzut*) and ground it to powder by a large stone on a flat slab of stone. Then we put this powder in a bag of cotton cloth and tied up the bag. The bag was then put in a small wooden tub or barrel and about 1½ gallons of hot water poured on the bag so as to completely immerse the

bag. The bag was raised and lowered once or twice to dissolve the copper sulphate. At the same time in another tub about 2 lbs. of slaked lime (*surti*) were mixed with 2 gallons of cold water. A big barrel of 25 gallons capacity was half filled with clean cold water and into this we poured the lime solution and the copper solution simultaneously, mixing them thoroughly by stirring with a long stick. A clean steel knife blade was put in the mixture. This was to find out whether there was any excess of copper. If the knife blade turned red, more lime had to be added, till the knife blade ceased to turn red. Water was then poured into the barrel till the whole bulk of the liquid rose to 25 gallons. This is usually called *normal Bordeaux mixture*, and we shall also call it by this name. In the evening the mixture was stirred up and some was taken out in a bucket. This was taken near the trees and the liquid was sprayed on to the trees by means of a bucket sprayer (see Fig. 2). The bucket sprayer we used was one made by Messrs. McDougall Bros. Co., Oriental Buildings, Bombay, costing Rs. 15. This type of sprayer is convenient for use for small trees such as grape vines. Each tree was thoroughly sprayed in every part. Each tree required about 1 pint of liquid and the time of operation on each tree was 30 seconds approximately. A second spraying was given on the third day afterwards by our *mâli* whom we left for that purpose.

The third spraying was given on November 20. This time a little soap ($2\frac{1}{2}$ lbs. soft soap) was added to the 25 gallons normal Bordeaux in order to make the spray effective against insects also and to cause it to stick to the leaves better. The vines treated at this time were in full leaf. They were flowering but not so far advanced as those in the rest of the vine-yard, which had been pruned a fortnight earlier. There were no indications of mildew either on treated or untreated vines. The vines which were sprayed on this visit were examined carefully next day. There was no sign of scorching even on the youngest leaves treated by the Bordeaux. Some flowers that had not opened the previous day had blossomed quite well. Elsewhere fruit had begun to set here and there.

The fourth spraying was given on December 14, 1909. The normal Bordeaux mixture was diluted up to 40 gallons, since the fruit was now completely set and it was desirable to avoid the possibility of giving it a too concentrated fluid. The spraying at this time was directed mainly against the bunches. At this time a grape plantation near the Takli village was inspected and found to be fully diseased. On the unsprayed portion of the vine-yard

Bucket Sprayer.

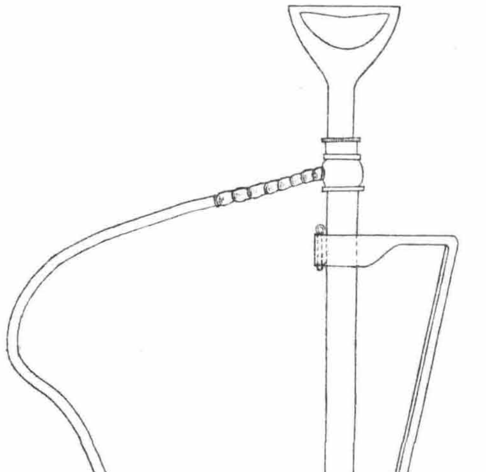


Figure 2.

in which we were working there was a very slight attack of mildew, chiefly at the tips of bunches. Four plants in our sprayed section had slight attack of mildew on the bunches, and twelve bunches in all were specially marked for observation as to the effect of the Bordeaux on checking the spread of the disease and saving the bunch. These bunches were examined at the time of the fifth spraying, December 28, 1909, and it was found that nine of the bunches were free of disease and that in three bunches the disease was still slightly appreciable. This fifth spraying was normal Bordeaux diluted to 50 gallons; that is, normal Bordeaux plus its own volume of water. The effect of our previous spraying was thought to be beneficial by the purchaser of the crop; in so far that the operation checked the extension of the pest, that the sprayed portion of the vines looked better in certain respects than the rest, that similar late pruned vines elsewhere fared much worse than ours, and that it was decidedly innocuous to the vine itself.

At our request Dr. Harold H. Mann, Principal of the Agricultural College, Poona, and Agricultural Chemist to the Government of Bombay, visited the plantation on March 1, and reported on its condition. Since Dr. Mann had been unconnected with the field experiment previously, his report may be looked on as reliable independent expert testimony :—

"POONA AGRICULTURAL COLLEGE.

Poona, March 14th, 1910.

"In accordance with your request, I visited Násik on Tuesday March 1st, 1910, in order to examine the condition of the vine-yard belonging to Ráo Sáheb Gole which has been partially sprayed during the present season as a preventive of mildew. At the time of my visit the grapes were almost ripe,—a certain proportion were ready for sale, and all would be ready within the present month.

"A general view of the sprayed and unsprayed portions of the vine-yard showed at once the generally more healthy appearance of the vines in the sprayed portion. With regard to the foliage, it was not that there was mildew on the unsprayed leaves and twigs, for this was remarkably missing at least in the living condition, but there was a decided absence of disease spots of any sort, either of past or present attack, on the foliage of the plants which have been sprayed. This fact could not be missed by even a casual observer. The leaves in the sprayed block still bore the marks of the spraying, which was very obvious, and it really appeared as if little had been lost since its application.

"Another point which was at once obvious was the fact that the most serious attack of mildew took place on the fruit stalk. In many cases in which the plants were otherwise quite free, and there was no attack on the fruit itself, the fruit stalk was white with mildew. Of course as I shall show below, there was a very great difference between the sprayed and unsprayed portions of the vine-yard in this particular, but the most susceptible point of the vine to the disease undoubtedly lies here.

"To compare the condition of things in the two portions of the vine-yard, I adopted two methods. First, I took two sets of five plants in the sprayed and unsprayed portions respectively and counted the total number and the number of affected bunches on each plant. Secondly, I examined in more detail every bunch on a typical plant in each section.

"The first method gave results as follows :—

"I. Plants taken at random.

(a) Unsprayed portion.

	Total Bunches.	Mildewed Bunches.
Plant 1	35	35
" 2	46	45
" 3	25	25
" 4	32	32
" 5	21	21
Total of five Plants ...	159	158

(b) Sprayed portion.

	Total Bunches.	Mildewed Bunches.
Plant 1	8	None.
" 2	13	1
" 3	17	2
" 4	21	10
" 5	7	None.
Total of five Plants ...	66	13

"Thus we have

(i) in the unsprayed portion, 99·4 per cent. bunches affected;

(ii) in the sprayed portion, 19·7 per cent. bunches affected.

"II. Plants taken in succession in a row.

(a) Unsprayed portion.

	Total Bunches.	Mildewed Bunches.
Plant 1	9	9
" 2	34	34
" 3	25	25
" 4	34	31
" 5	47	44
Total of five Plants ...	149	143

(b) Sprayed portion.

	Total Bunches.	Mildewed Bunches
Plant 1	38	15
" 2	22	10
" 3	12	3
" 4	9	4
" 5	41	14
Total of five Plants ...	122	46

"Thus we have again

(i) in the unsprayed portion, 96·0 per cent. bunches affected;

(ii) in the sprayed portion, 37·7 per cent. bunches affected.

"The difference is very clear. Though most of the affected bunches are only attacked on the fruit stalk, yet the difference between the two cases is very marked.

"I now turned to a more detailed investigation of a typical vine in the sprayed and unsprayed portions of the vine-yard. The following were the results of my examination of each fruit-bearing branch of such vines:

"*I. Vine in unsprayed portion of vine-yard.*—The leaves on every branch had been affected by several diseases, the nature of which I did not attempt to investigate. They were very spotty, but no mildew present that I could see.

Branch.	Number of Bunches.	Condition of Fruit Stalk.	Grapes.		
			Total.	Slightly mildewed	Badly mildewed
1	1	Badly mildewed	75 (?)	1	...
2	1	Very badly mildewed	41	21	4
3	1	Do.	62	41	9
4	1	Badly mildewed	72	12	2
5	1	Do.	75 (?)	3	...
6	1	Do.	62	44	10
7	1	Do.	48	10	3
8	1	Very badly mildewed down to tip ...	75 (?)	3	...
9	1	Badly mildewed	26	3	1
10	2	*a*. Slightly mildewed	No fruits affected.		
		b. Very badly mildewed	66	4	3
11	2	*a*. Badly mildewed	75 (?)	1	1
		b. Slightly mildewed	No fruits affected.		
12	1	Very badly affected	70	12	1
13	1	Badly affected	32	2	...
14	3	*a*. Badly affected (not ripe)	24	3	...
		b. Badly affected	70 (?)	4	...
		c. Do.	60 (?)	1	...
15	2	*a*. Do.	50 (?)	6	...
		b. Do.	No fruits affected.		
16	1	Do.		Do.	
17	1	Do.		Do.	
18	1	Do.		Do.	
19	1	Badly affected	50 (?)	1	1
20	1	Do. (not ripe)	30 (?)	...	1
21	1	Badly affected	70 (?)	4	...
22	1	Do. (not ripe)	44	14	3
23	1	Badly affected	60 (?)	6	...
24	2	*a*. Very badly affected	61	20	6
		b. Do. (not ripe)	No fruits affected.		
25	1	Badly affected	27	15	4

"That is to say that in every case the fruit stalk was more or less mildewed, but the amount of affection in the fruits is very variable. Out of thirty-one bunches of grapes, seven only were quite free. In the cases where a note of interrogation is attached to the total number of grapes in a bunch, this number was estimated, but is probably very nearly correct.

"*II.—Vine in sprayed portion of vine-yard.*

Branch.	Number of bunches.	Condition of fruit stalk.	Grapes. Total.	Slightly mildewed.	Badly mildewed.
1	1	No mildew	...	No fruits affected.	
2	1	Do.	...	Do.	
3	1	Do.	...	Do.	
4	1	Do.	...	Do.	
5	1	Badly affected	24	4	...
6	1	Do.	51	20	10
7	1	Do.	75 (?)	3	2
8	1	Slightly affected	50 (?)	2	...
9	1	Badly affected	40	1	1
10	1	Do.	14	5	1

" If we summarise these results we find as follows :—

	Unsprayed portion.	Sprayed portion.
	Per cent.	Per cent.
Fruit stalks—		
Not affected	...	40·0
Slightly affected	6·5	10·0
Badly affected	74·2	50·0
Very badly affected	19·3	...
Fruits—		
Bunches affected	77·4	40·0
Bunches free	22·6	60·0
Grapes in affected bunches—		
Slightly affected	17·4	13·8
Badly affected	3·7	5·5
Free from mildew	78·9	80·7

" This would indicate very clearly the extent to which the spraying this year has been effective in keeping the plants and fruits free from mildew. The number of bunches in which the grapes themselves are attacked on these typical plants has been reduced from 77·4 to 40 per cent. of those present, but these bunches in which the fruits are affected seem to have been damaged nearly as much as in the unsprayed plants. This would seem to indicate that if your spraying does not succeed in preventing the disease appearing, then the only chance is to spray so late as to have the Bordeaux mixture sticking to the fruits themselves.

"In the present instance copper was present to the eye on many of the bunches of grapes but not on all. The amount was nothing like so great as in the case of your Mundhwa experiments. Even the amount which was present was objected to by the owner as lowering the appearance and hence the value of the grapes. But this, I know, you have already considered."

The following letter from Mr. H. V. Gole testifies also to the good effect of the treatment :—

"Násik, 2nd February 1910.

"As regards the 100 vines which were treated with Bordeaux mixture I am glad to write that the general result of the sprayings has been satisfactory. The appearance of the fruit is healthy and the fruit in the unsprayed portion does in no way stand comparison with the fruit in this portion. It is remarkable that in the 100 plants sprayed mildew is totally or almost so absent, while in the unsprayed portion mildew is more or less present.

"Well, you remember the spot where all the four varieties are grown near together. Many of the bunches of these vines were affected with mildew. We gave them only one spray. The result is remarkable. The further spread of the pest appears to have been checked. However the berries that were attacked first have a sickly appearance and the scars on them give the bunches an unpleasant appearance. But on the whole the effect of such a late spraying was to check the further growth of mildew.

"I had not noted the bunches sprayed in other parts of the garden and I am unable to say anything regarding them.

"I now turn to another matter. The surface of the berries holds a portion of the copper compound—which is very poisonous. Allow me to draw your attention to pages 232 and 233 of "The Spraying of Plants" by Lodeman. How to get rid of the poison is the next question, supposing that the grapes are not properly sprayed with a well prepared Bordeaux mixture. Already grape-growers and *Bagwans* are talking about the poisonous effects of the sprayings and it is very necessary that we—I mean you of the Department – should explain to these men the truth about the use of Bordeaux mixture and set their minds at rest."

The point referred to by Dr. Mann in his last paragraph and Mr. Gole in his letter, namely, the appearance of copper on the grape bunches, will be treated in a subsequent paragraph in this bulletin.

V. *The Mundwa Experiment.*—The plan of experiment here was similar to that carried out in Násik. 100 vines were treated and the rest kept for control observation. The sprayings were as follows :—The first spraying was given in October 20, 1909, with

normal Bordeaux plus soap. No scorching was observed. The second spraying was done on November 20 with the normal Bordeaux plus soap. The berries were just beginning to form. Traces of the last spraying were still visible on the leaves. The young growth showed 6 to 10 leaves more since last spraying and the total length of branches was 2 to 3 feet. The third spraying was done on January 19, 1910, with normal Bordeaux made up to 40 gallons. Mildew was not much in evidence in the sprayed portion. Indications of it were seen on the stalks of bunches and on several berries also. There was considerably more mildew in the unsprayed section. Spraying was directed chiefly against the stalks of bunches, with the result that on examination of these bunches on February 8, 1910, no mildew was noticeable on the bunch stalks. On the whole the unsprayed part of the Mundwa garden was not nearly so badly attacked by mildew as the unsprayed section of the Násik garden, so the effect of the spraying, though beneficial, was not marked. A peculiar brown cracked scurf formed on many of the berries in the Mundwa garden and spoiled the growth and appearance of many of them in both sprayed and unsprayed portion. Repeated microscopic examination of this scurf was made to see if it was due to mildew but no trace of fungus was ever to be found. This scurf will be further studied.

VI. *The Ganeshkhind Experiment.*—Soon after pruning, all the vines in Ganeshkhind Botanical Garden were sprayed on 15th October 1909 with normal Bordeaux. On 17th December spraying was done with normal Bordeaux. The third spraying was on January 3, 1910, with normal Bordeaux plus soap. The last spraying was given on January 17, 1910, with normal Bordeaux plus soap. Mildew was first observed on 15th December. On January 17th, several mildewed fruits were removed. On February 4th, the following observation was recorded in the cultivation sheet of the Ganeshkhind Botanical Garden :—

"The last spraying seems to have checked mildew as none appears now on the bunches nor on the leaves, but instead all leaves and bunches are thickly stained with the Bordeaux mixture."

VII. *The removal of the stains of Bordeaux mixture from the grapes.*—It was obvious that the grapes could not be sold while still stained by spots of Bordeaux mixture. In the case of the Ganeshkhind Botanical Garden grapes, these spots were specially conspicuous since normal Bordeaux had been used all through. At Mundwa the stains were less visible, and at Násik the stains were still less visible. The Agricultural Chemist, Dr. Mann, kindly made several analyses to find out the actual amount of copper on

certain bunches of berries. This was done to discover whether the copper in the Bordeaux was really present in sufficient amount to be poisonous. The following are the analyses :—

Three samples of grape bunches from Ganeshkhind Garden, sprayed with Bordeaux mixture.

	Weight of bunch.	Soluble copper.	Insoluble copper.	Number of berries.
		Grams.	Grams.	
Small bunch	28·5	·011	·004	41
Middle size bunch	38·5	·016	·008	53
Big bunch	72·0	·020	·009	84

Samples of grapes sprayed with Bordeaux mixture.

	Sample from Nāsik.	Samples from Mundhwa.		
		A.	B.	C.
	Grams.	Grams.	Grams.	Grams.
Weight of the bunch	111·00	197·00	203·00	124·00
	No.	No.	No.	No.
Numbers of grapes in the bunch ...	51	55	67	51
	Grams.	Grams.	Grams.	Grams.
Copper, soluble	·004	·006	·007	·006
Copper, insoluble	·003	·002	·003	·003
Total amount of copper present in each of these bunches.	·007	·008	·010	·009

A sample bunch of Mundhwa grapes immersed and stirred in water for 20 minutes.

Weight of the bunch	... ...	144 grams.
Number of berries in the bunch	...	68
Insoluble copper	... ...	0·006 grams.
Soluble copper	... ...	0·003 grams.

It will be noted that in every case in Mundwa and Násik the amount of copper present is extremely small and could have absolutely no detrimental effect on the eater. In the Ganeshkhind Botanical Garden grapes, as previously mentioned, the deposit of copper was much heavier on account of the fact that normal Bordeaux was used all the way through. However even in the heaviest sprayed bunch the amount of total copper is only ·024 grams in a bunch, weight 38·5 grams. The U. S. Department of Agriculture Farmers' Bulletin No. 7, 19 quoted by Lodeman in his "Spraying of Plants," page 232, says: "Accepting then 0·5 grams as the maximum amount of copper in any of the forms discussed that may with safety be daily absorbed, let us see how these figures compare with the quantity of this metal found in connection with properly sprayed fruits." It will be seen from the analyses quoted above that, judged by this standard, the amount of copper in the sprayed bunches is innocuous. However, the stains decrease the market value of the grapes, hence it is desirable to remove these stains without spoiling the delicate grey bloom of the grape. Dr. Mann suggested washing in vinegar, and on 8th February in the Mundwa garden this experiment was actually tried. It was found that steeping for one minute in ordinary table vinegar and washing for one minute in clean water effectually removed the stains. The same result was got from dipping in sugarcane juice that had been allowed to ferment thoroughly in the sun and had then been strained, and then dipping in clean water. Mr. Kirtane reported that he had kept grapes in water over night and that next morning the spots had mostly disappeared. It seems to us that for quick and effective cleaning, especially where the spraying has been heavy it is desirable to dip in vinegar or fermented sugarcane juice. In cases of slight stain the steeping in water for one night will probably be effective.

VIII. *Conclusions and recommendations.*—As a result of one year's work we may say that Dr. Mann's conclusions as regards the Násik plantation are borne out by the other experiments.

Our recommendations to grape-growers in districts liable to mildew are as follows :—

(1) Thoroughly clean the vines by rubbing off all loose bark, and by cutting out all dead and cracked spurs.

(2) Keep the vine-yard free from weeds and do not give excess of water, especially when the weather is cloudy.

(3) Spray with Bordeaux according to the following scheme :—

Time.		Strength of Bordeaux.		
		Copper sulphate.	Lime.	Water.
		Lbs.	Lbs.	Gallons.
1st spraying on day of pruning in October ...		3	2	25
2nd " one month later		3	2	25
3rd " " "	Spray the *bunches* specially, if they are present, but do not spray flowers directly.	3	2	50
4th " " "		3	2	50
5th " " "		3	2	50

After the April pruning, spraying should be again done once a month with the normal Bordeaux mixture plus soap. When planting new-cuttings, the cuttings should be dipped in normal Bordeaux plus soap for a few seconds and allowed to dry before planting.

Spraying should be done in the evening in the hour before sunset. The liquid thus remains on the leaves for a longer time without getting dried up, and there is no danger of the drops of liquid acting as lenses to the sunlight and burning the leaves.

Cost of spraying.

The following is an estimate of the cost of spraying :—

(1) Initial cost—

	Rs.	a.	p.
Barrel—25 to 30 gallons capacity	4	0	0
Tub or small barrel	2	0	0
Bucket	0	13	0
Kerosine tin	0	3	0
Prize sprayer (McDougall Bros. Co.) ...	15	0	0
	22	0	0

(2) Materials, etc., for each spraying of 100 trees with normal Bordeaux—

	Rs.	a.	p.
Copper sulphate 1½ lbs.	0	12	0
Lime 1 lb.	0	0	6
Soap 1 lb.	0	0	6
	0	13	0

(3) Labour (will vary according to locality, etc.).

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